# ESTIMATION OF OPTIMUM STIMULUS AMPLITUDE FOR BALANCE TRAINING USING ELECTRICAL STIMULATION OF THE VESTIBULAR SYSTEM

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Sensorimotor changes such as posture and gait instabilities can affect the functional performance of astronauts after gravitational transitions. Sensorimotor Adaptability (SA) training can help alleviate decrements on exposure to novel sensorimotor environments based on the concept of “learning to learn” by exposure to varying sensory challenges during posture and locomotion tasks (Bloomberg 2015). Supra-threshold Stochastic Vestibular Stimulation (SVS) can be used to provide one of many challenges by disrupting vestibular inputs. In this scenario, the central nervous system can be trained to utilize veridical information from other sensory inputs, such as vision and somatosensory inputs, for posture and locomotion control. The minimum amplitude of SVS to simulate the effect of deterioration in vestibular inputs for preflight training or for evaluating vestibular contribution in functional tests in general, however, has not yet been identified. Few studies (MacDougall 2006; Dilda 2014) have used arbitrary but fixed maximum current amplitudes from 3 to 5 mA in the medio-lateral (ML) direction to disrupt balance function in healthy adults. Giving this high level of current amplitude to all the individuals has a risk of invoking side effects such as nausea and discomfort. The goal of this study was to determine the minimum SVS level that yields an equivalently degraded balance performance.

Thirteen subjects stood on a compliant foam surface with their eyes closed and were instructed to maintain a stable upright stance. Measures of stability of the head, trunk, and whole body were quantified in the ML direction. Duration of time they could stand on the foam surface was also measured. The minimum SVS dosage was defined to be that level which significantly degraded balance performance such that any further increase in stimulation level did not lead to further balance degradation. The minimum SVS level was determined by performing linear fits on the performance variable at different stimulation levels. Results from the balance task suggest that there are inter-individual differences and the minimum SVS amplitude was found to be in the range of 1 mA to 2.5 mA across subjects. SVS resulted in an average decrement of balance task performance in the range of 62%-73% across different measured variables at the minimum SVS amplitude in comparison to the control trial (no stimulus). Training using supra-threshold SVS stimulation is one of the sensory challenges used for preflight SA training designed to improve adaptability to novel gravitational environments. Inter-individual differences in response to SVS can help customize the SA training paradigms using minimal dosage required. Another application of using SVS is to simulate acute deterioration of vestibular sensory inputs in the evaluation of tests for assessing vestibular function.

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